DOCUMENT RESUME

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ABSTRACT

In this activity, students test whether the color of a material affects how much heat it absorbs. An ice cube is placed in a box made of colored paper (one box per color; white, yellow, red, and black) which is then placed in the sun. Students predict which color will melt the ice cube first and record the order and time required for the ice cubes to melt. This activity can be done independently or in conjunction with both a math and/or science lesson. A discussion and journal-writing period can follow. For a more challenging activity, a discussion about solar energy can be included. This activity is designed uses a time frame of 60 minutes. (Author/SOE)

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Activity: **Do Different Colors Absorb Heat Better?**

GRADE LEVELS: pK-2

SUMMARY:

Students test whether the color of a materials affects how much heat it absorbs. Students will place an ice cube in a box made of colored paper (one box per color; white, yellow, red and black), which they will place in the sun. The students will make prediction as to which color will melt the ice cube first. They will record the order and time required for the ice cubes to melt. This activity can be done independently or in conjuction with both a math and/or science lesson. A discussion and journal-writing period can follow. For a more challenging activity, a discussion about solar energy can be included.

LEVEL OF DIFFICULTY [1=Least Difficult: 5=Most Difficult]

4- difficult

TIME REQUIRED

60 minutes (1-2 class periods)

COST

Less than $10 per class

STANDARDS:

1.1 Identify and describe characteristics of natural (e.g. wood, rocks, wool) and human-made materials (e.g. Styrofoam, plastic, fabric).

1.2 Identify some possible uses and advantages for natural and human-made materials.

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WHAT WILL THE STUDENTS LEARN?

Certain colors absorb light better than others

The sun produces heat and light

Why ice cubes melt

The purpose of solar panels

BACKGROUND INFORMATION:

VOCABULARY:

SOLAR ENERGY: energy derived from sunlight

SOLAR CELL: a photo-electric cell that converts sunlight directly into electrical energy and can be used as a power source

SOLAR PANEL: a group of solar cells forming a flat surface (as on a spacecraft)

HEAT: a form of energy that causes substances to rise in temperature or to go through associated phase changes (as melting, evaporation, or expansion)

ENERGY: the capacity for doing work; raising weight, for example.

ABSORB: to take in; to transform (radiant energy) into a different form usually with a resulting rise in temperature

REFLECT: to bounce waves of light, sound, or heat off a surface

RADIANT ENERGY: energy (as heat waves, light waves, radio waves, X rays) transmitted in the form of electromagnetic waves

MELTING: (in terms of an ice cube)

The sun emits energy in the form of electromagnetic waves. We see part of the electromagnetic wave as light and we feel part of it as warmth. Darker colors absorb more sunlight than lighter colors, which is why darker colors get warmer more quickly in the sunlight than lighter colors. The lighter colors reflect more of the sun's radiant energy, so they remain cooler to touch in the sunlight.

RESOURCES:

http://newton.dep.anl.gov/askasci/gen99/gen99540.htm - Answers the question of why different colors absorb more or less heat

http://newton.dep.anl.gov/askasci/phy00/phy00156.htm - Further explanation of heat absorption and different colors

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MATERIALS:

4 sheets of colored paper per group (white, yellow, red, black)

Newspaper

Scissors (1per student if you want the class to cut out the boxes)

4 ice cubes per group

sunny day or a heat lamp

PREPARATION:

Make enough ice cubes so that each group can have four. Try to make them the same size so that the experiment is consistent.

Cut out the colored paper into 5 sided boxes big enough to fit the ice cube for each group. To save class time tape the boxes together, or if time is availible have the students cut, fold and tape their own boxes together.

Obtain the rest of the materials.

Photocopy one chart per group (see link).

For shorter lesson, precut and assemble colored boxes

DIRECTIONS:

1. Ask them to imagine that it is 100-degrees outside. What kinds of things will they do to stay cool? What kinds of clothing will they wear? Any thought to color? Once the class is thinking about the influence of color and its relationship to heat.

2. Divide the class into small groups.

3a. For a shorter lesson have the colored boxes pre-cut and assembled and hand out one of each color for each group of students.

3b. For a more involved activity give each group 4 sheets of colored paper (white, yellow, red, black) and have them cut and fold thier sheet into a box.

4. Hand out newspaper and have each group spread the newspaper under the heat lamp or in a sunny place outside.

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5. On the newspaper, place the boxes side by side with the opening facing away from the sun/light so the students can see inside.

6. Give each group 4 ice cubes and instruct them to place 1 ice cube in the center of each colored cube.

7. Let the ice cubes sit in the sun until they have melted. Have the students check on them every few minutes and record which ice cubes melted first, second, third, and fourth.

8. Instruct each group to record their data on the chart (see link).

9. Discuss with the class their observations, touching on the different colors and their ability to reflect light and heat. Also talk about how these characteristics of color help to melt the ice.

INVESTIGATING QUESTIONS:

Why do ice cubes melt?

How does the sun affect ice?

What kind of clothes do people wear outside in the winter/summer?

On which color did the first ice cube completely melt? Why?

If an ice cube was placed on a blue piece of paper, how much time do you think it would take to completely melt?

Which color absorbs heat the quickest in the sun?

Which color would be the best to help keep ice cubes from melting too quickly in the sun?

FOR A MORE CHALLENGING ACTIVITY: a discussion of solar panels and solar energy could be included. Also, discuss heat as a form of energy.

REFERENCES:

Richards, Roy. An Early Start to Technology from Science. London: Simon & Schuster, 1990, page 64.

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Rubric for Performance Assessment						
Activity Title: Grade Level:	Do Different Colors Absorb Heat Better?			Grade level:	PK-2	
	1	2	3	4		
Criteria	Beginning	Developing	Proficient	Advanced	Weight (X factor)	Subtotal
TESTING OF KNOWLEDGE AND CONCEPTS	Does not understand the key concepts of how an ice cube melts.	Understands some of the key concepts of how various colors absorb heat differently.	Able to explain how an ice cube melts with respect to different colors absorbing heat in different ways.	Able to explain how an ice cube absorbs heat and its implications towards solar energy.		
TEAMWORK	No group work.	Little contribution to group work.	Contributes as expected to group work.	Contributes above expectations.		
					Total:	
Teacher Comments:						

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Name

Date _____

Do Different Colors Absorb Heat Better than Others?

Colors	Time to Melt (min)
White	
Yellow	
Red	
Black	

Which ice cube melted first? _____

Which ice cube melted second? _____

Which ice cube melted third? _____

Which ice cube melted fourth? _____

Do different colors absorb heat better than others? _____

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Activity Evaluation Form
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Activity Name: _____

Grade Level the Activity was implemented at:

Was this Activity effective at this grade level *(if so, why, and if not, why not)?*

What were the Activity's strong points?

What were its weak points?

Was the suggested Time Required sufficient (if not, which aspects of the Activity took shorter or longer than expected)**?**

Was the supposed Cost accurate (if not, what were some factors that contributed to either lower or higher costs)**?**

Do you think that the Activity sufficiently represented the listed MA Framework Standards (if not, do you have suggestions that might improve the Activity's relevance)**?**

Was the suggested Preparation sufficient in raising the students' initial familiarity with the Activity's topic (if not, do you have suggestions of steps that might be added here)**?**

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If there were any attached Rubrics or Worksheets, were they effective (if not, do you have suggestions for their improvement)?

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I. DOCUMENT IDENTIFICATION:

Title: PreK-12 Engineering Activities

1) Touch and Discover, Grades PreK-2
http://www.prek-12engineering.org/data/d2/Touchdiscover.pdf

2) Invent a Backscratcher from Everyday Materials, Grades PreK-2
http://www.prek-12engineering.org/data/d28/Backscratcher.pdf

3) Compare Human-Made Objects with Natural Objects, Grades PreK-5
http://www.prek-12engineering.org/data/d34/HumanvsNatural.pdf

4) Do Different Colors Absorb Heat Better?, Grades PreK-2
http://www.prek-12engineering.org/data/d37/Absorbheat.pdf

5) Which Roof is Tops?, Grades PreK-2
http://www.prek-12engineering.org/data/d44/RoofTops.pdf

6) Make Your Own Recycled Paper, Grades PreK-2
http://www.prek-12engineering.org/data/d56/Recycle.pdf

7) Build an Approximate Scale Model of an Object Using LEGOs, Grades 3-5
http://www.prek-12engineering.org/data/d3/LegoScaleModel.pdf

8) Design Weather Instruments using Lego Sensors, Grades 3-5
http://www.prek-12engineering.org/data/d4/LegoWeather.pdf

9) Space Shelter, Grades 3-5
http://www.prek-12engineering.org/data/d5/SpaceShelter.pdf

10) Build a Bird House, Grades 3-5
http://www.prek-12engineering.org/data/d6/BirdHouse.pdf

11) Ball Bounce Experiment, Grades 3-5
http://www.prek-12engineering.org/data/d6/BallBounce.pdf

12) Make an Alarm!, Grades 3-5
http://www.prek-12engineering.org/data/d11/MakeAlarm.pdf

13) Design Packing to Safely Mail Raw Spaghetti, Grades 3-5
http://www.prek-12engineering.org/data/d17/MailSpaghetti.pdf

14) Disassemble a Click Pen, Grades 3-5
http://www.prek-12engineering.org/data/d33/clickPen.pdf

15) Construct And Test Roofs for Different Climates, Grades 3-5
http://www.prek-12engineering.org/data/d35/ClimateRoof.pdf

16) Compare Fabric Materials, Grades 3-5
http://www.prek-12engineering.org/data/d36/Fabric.pdf

17) A House is a House for Me, Grades 3-5
http://www.prek-12engineering.org/data/d52/House.pdf

18) Water Filtration, Grades 3-5
http://www.prek-12engineering.org/data/d53/Water Filtration.pdf

19) What is the Best Insulator: Air, Styrofoam, Foil, or Cotton?, Grades 3-5
http://www.prek-12engineering.org/data/d54/BestInsulator.pdf

20) Design a Recycling Game!, Grades 3-5
http://www.prek-12engineering.org/data/d55/Recycling.pdf

21) Tower Investigation and the Egg, Grades 6-8
http://www.prek-12engineering.org/data/d7/TowerEgg.pdf

22) Wimpy Radar Antenna!, Grades 6-8
http://www.prek-12engineering.org/data/d10/WimpyAntenna.pdf

23) Portable Sundial, Grades 6-8
http://www.prek-12engineering.org/data/d30/PortableSundial.pdf

24) An Introduction To Loads Acting on Structures, Grades 6-8
http://www.prek-12engineering.org/data/d31/IntroLoads.pdf

25) Design Your Own Rube Goldberg Machine, Grades 6-8
http://www.prek-12engineering.org/data/d32/RubeGoldberg.pdf

26) Building Tetrahedral Kites, Grades 6-8
http://www.prek-12engineering.org/data/d38/tetrakites.pdf

27) Do as the Romans: Construct an Aqueduct!, Grades 6-8
http://www.prek-12engineering.org/data/d39/Aqueduct.pdf

28) Build an Earthquake City!!, Grades 6-8
http://www.prek-12engineering.org/data/d40/EarthquakeCity.pdf

29) Design a Parachute, Grades 6-8
http://www.prek-12engineering.org/data/d41/Parachute.pdf

30) The Squeeze is On, Grades 6-8
http://www.prek-12engineering.org/data/d42/Squeeze.pdf

31) Stop The Stretching, Grades 6-8
http://www.prek-12engineering.org/data/d43/StopStretching.pdf

32) Speaker Project, Grades 9-10
http://www.prek-12engineering.org/data/d13/Speaker.pdf

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